SMART: Selective Membrane Air Revitalization Technology

Completed Technology Project (2016 - 2017)

Project Introduction

Determine if Gas Permeable Membrane Modules remove Carbon Dioxide (CO2) in a Closed-Circuit Breathing Apparatus (CCBA). These modules do not produce unwanted heat and have an essentially unlimited lifetime compared to traditional CO2 scrubbers. Determining the optimal circuit configuration to remove sufficient CO2 from the breathing circuit while retaining oxygen is a major challenge. Determine the optimal module capacities, flow rates, and pressures. Test a breadboard breathing circuit using membrane-based separation to determine whether it has sufficient performance and reliability for operational use in a CCBA. Designed and developed an air revitalizing system using semi-permeable membranes. CO2 passes through the membrane much more rapidly than O2 and N2 allowing the gases to be separated. Assemble a bench testing apparatus which simulates a closed circuit breathing system. Flow compressed gas through the membrane with a similar composition of exhaled air (~4-5% CO2). Pressure, flow, and gas composition will be continuously monitored. Test a variety of membrane module configurations (series, parallel, etc.) at a wide range of pressures and flows, with the goal of reducing CO2 level to <2%, which is considered safe for breathing air. When an optimal configuration with adequate flow and output composition is identified, it will be integrated into a CCBA and breathing machine tests will be performed. At a larger scale the same design will be applicable to a spacecraft or habitation module.

Anticipated Benefits

Demonstrate long duration, zero maintenance, Gas Permeable Membrane modules for Carbon Dioxide (CO2) removal in life support systems. Closed circuit breathing apparatus (CCBA) such as those used in the Extravehicular Mobility Unit (EMU) and manned spaceflight (Shuttle, International Space Station), CO2 is removed by absorption and a chemical reaction. Using current technology, CO2 removal is from LiOH canisters, which are temperature dependent, generate unwanted heat, and are limited by the amount of absorbent in the CO2 scrubber; limiting flight time. These canisters are not re-generable, bulky in size and weight, and are not suitable for long-term operations.

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Center Innovation Fund: KSC CIF

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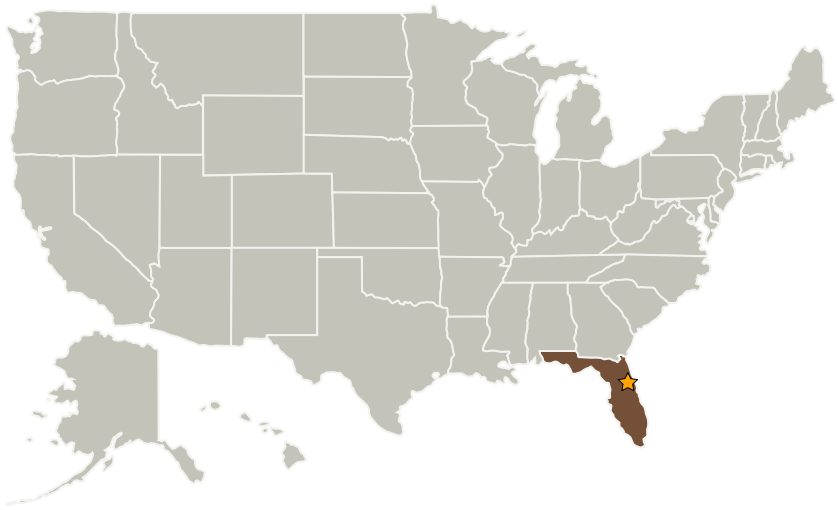
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida

Primary U.S. Work Locations
Florida

Project Management

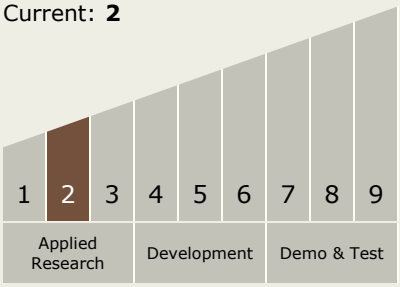
Program Director:
Michael R Lapointe

Program Manager:
Barbara L Brown

Principal Investigator:
Rolando Valdez

Technology Maturity (TRL)

Start: **2**
Current: **2**



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.1 Environmental Control & Life Support Systems (ECLSS) and Habitation Systems
    - TX06.1.1 Atmosphere Revitalization

Target Destinations

Earth, The Moon